



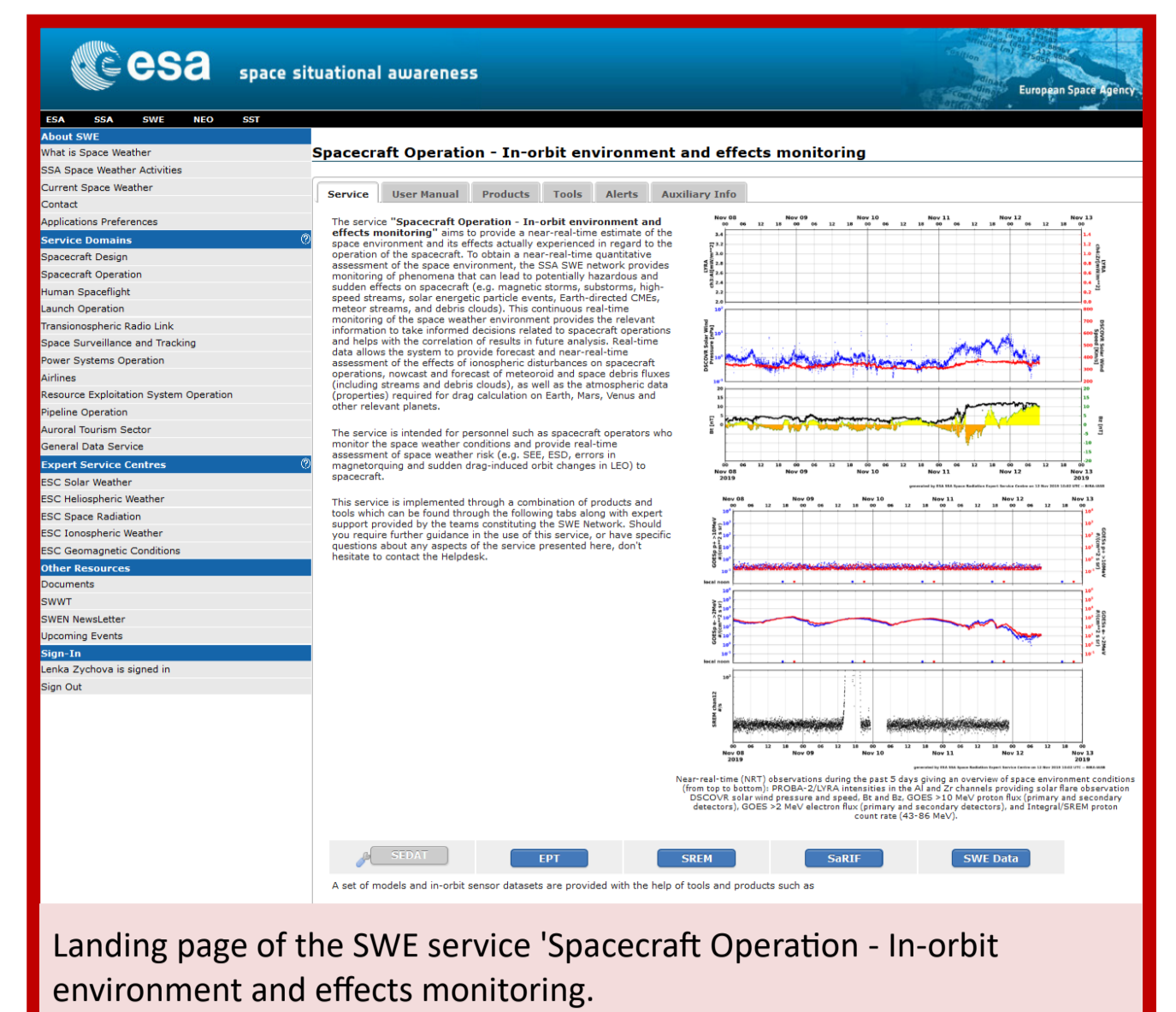
ESA SSA Space Radiation Expert Service Centre: **Spacecraft Operation Domain**

Lenka Zychova¹, Mark Dierckxsens¹, Norma Crosby¹, Chris Perry², Alexi Glover^{3,4}

¹Royal Belgian Institute for Space Aeronomy (BIRA-IASB) ²RAL Space, STFC Rutherford Appleton Laboratory ³ESA/ESOC ⁴Space Safety Programme Office

- ▶ Spacecraft Operation is one of the SSA Space Weather Service domains, providing five services.
- ▶ Four services are under the responsibility of the Space Radiation Expert Service Centre (R-ESC).
- ▶ The Heliospheric Weather Expert Service Centre (H-ESC) is responsible for the remaining service "Space Weather in the Solar System".
- ▶ Here we highlight some of the products contributing to the services under the Spacecraft Operation domain.

<http://swe.ssa.esa.int/spacecraft-operation>



Landing page of the SWE service 'Spacecraft Operation - In-orbit environment and effects monitoring'.

IN-ORBIT ENVIRONMENT AND EFFECTS MONITORING

This SWE service aims to provide a near-real-time estimate of the space environment and its effects actually experienced in regard to the operation of the spacecraft.

EPT

PROBA-V/EPT data and derived products

Federated products from the Center for Space Radiations (UCL)

- ▶ Electron, proton and helium flux data as measured by the Energetic Particle Telescope (EPT) on board PROBA-V.
- ▶ Products include flux time series, weekly geographical flux maps, and characteristic spectra for specific regions.

SREM

SREM space radiation situation reports

Federated products from Paul Buehler (Austria)

- ▶ A concise overview of the proton and electron radiation levels in key-regions of space on a daily basis.
- ▶ Data from SREM instruments on the following satellites: Proba-1, Integral, Rosetta, Herschel, Planck, and Rosetta.

POST EVENT ANALYSIS

This SWE service aims to provide the possibility to correlate a particular spacecraft effect experienced during the operation of a spacecraft with space environment data.

SEPEM

Solar Energetic Particle Environment Modelling application server

Federated products from the Space Physics Division (BIRA-IASB)

- ▶ Web interface to solar energetic particle data and a range of modelling tools and functionalities.
- ▶ A large number of raw and cleaned data sets are easily accessible.

UTU-SEP

High-energy solar proton events

Federated products from the Space Research Laboratory (UTU)

- ▶ A catalogue of SEP events based on SOHO/ERNE observations of 55–80 MeV protons.
- ▶ Provides information on event start and end times, peak intensity, proton and heavy ion fluence, and information on associated solar flares and CMEs.

IN-ORBIT ENVIRONMENT AND EFFECTS FORECAST

This SWE service aims to provide an estimate for the near future of the space environment and its effects in regard to the operation of the spacecraft.

SPM

SWIFF Plasmasphere Model

Federated products from the Space Physics Division (BIRA-IASB)

- ▶ The 3D dynamic model of the plasmasphere calculates the number density and the temperature of the electrons inside and outside the plasmasphere.
- ▶ The model runs once a day using predicted Kp values providing a forecast of the electron number density and temperature for the following day.

SaRIF

Satellite Risk Prediction and Radiation Forecasts

Federated products from the Met Office and British Antarctic Survey (BAS)

- ▶ A table of colour-coded risk indicators showing the risk from internal charging and the total ionising dose rate for GOES-15, GOES-14, GIOVE-A and a satellite in an equatorial orbit at 8000 km altitude.
- ▶ The risk indicators are based on the latest available data and model results which are updated hourly.

MISSION RISK ANALYSIS

This SWE service aims to provide the necessary information to perform a mission risk analysis and an assessment of the mission susceptibility for a given spacecraft due to the expected space environment conditions.

MSSL

Electron Population Model

Federated products from the Mullard Space Science Laboratory (UCL)

- ▶ An empirical model of the omnidirectional 10 eV to 40 keV electron population parameterised by solar wind velocity and magnetospheric activity levels (kp).
- ▶ Data is provided in three regions defined by L-shells: LEO (L<4), MEO (L=4-6) and GEO (L=6-7).

SPENVIS

SPace Environment Information System

Federated products from the Met Office and British Antarctic Survey (BAS)

- ▶ Web interface to models of the space environment and their induced effects, including cosmic rays, natural radiation belts, solar energetic particles, plasmas, gases, and "microparticles".
- ▶ A tool to visualise satellite data produces panel plots of measured quantities in combination with geomagnetic and solar indices.

SPACE WEATHER IN THE SOLAR SYSTEM

This SWE service aims to provide forecasts, nowcasts and alerts related to space weather in the heliosphere.

UK Met Office

3D MHD (WSA/Enlil) Model - Inner Solar System

Federated products from the UK Met Office

- ▶ Targeted forecasts are currently produced for Mercury, Venus and Mars in addition to the Earth.
- ▶ Human forecaster assessment is provided alongside the model output to provide warnings of CME arrival and high speed solar wind streams.

RAL Space

Solar System Space Weather Timeline

Federated products from the Heliospheric Weather Expert Service Centre - Product Assessment Report

- ▶ The space weather timeline provides an ongoing and historical list of CME propagation forecasts and in-situ detection of CME and High Speed Streams.
- ▶ The timeline provides a summary of the event and links to supporting SWE network products that can provide more details or analysis.

